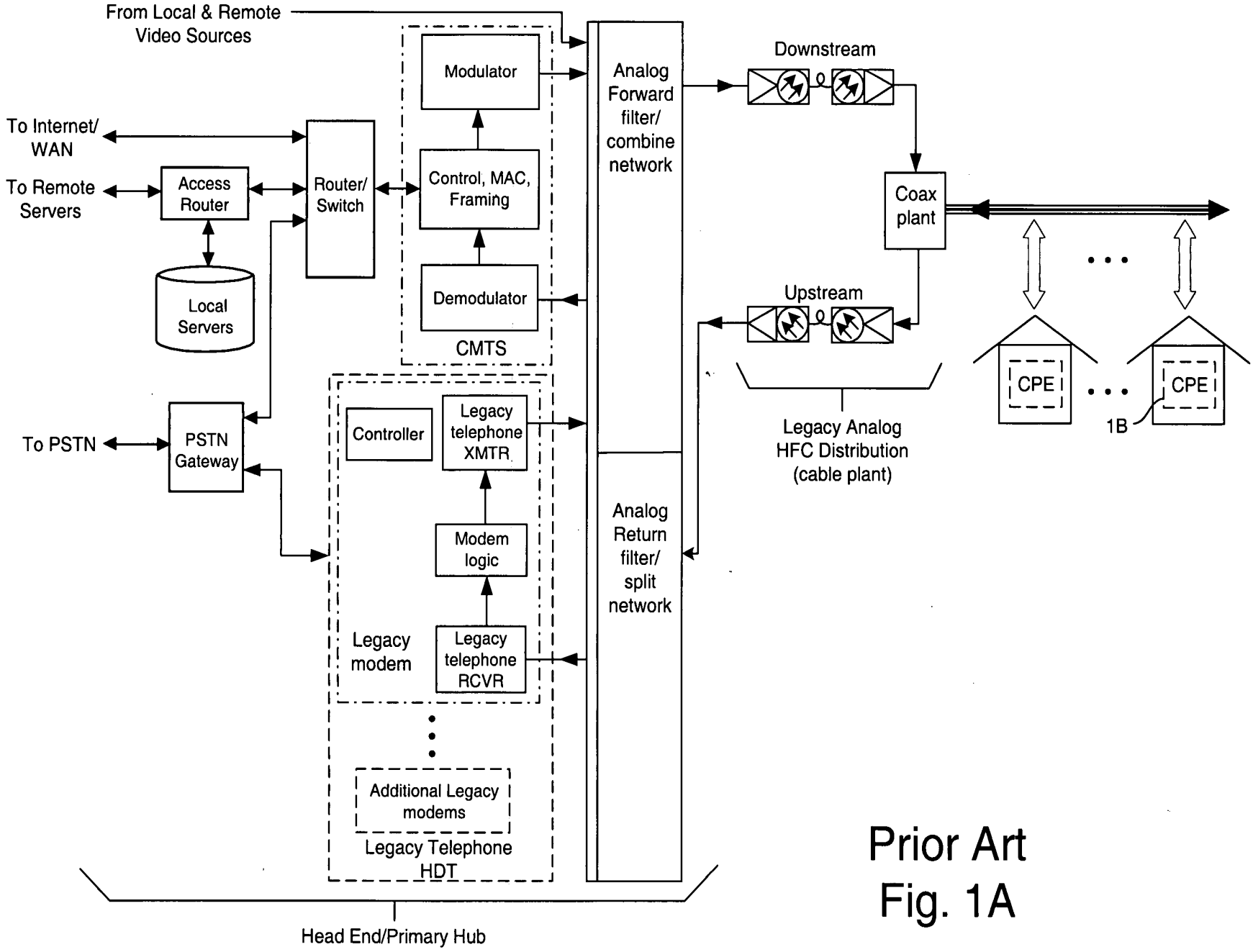
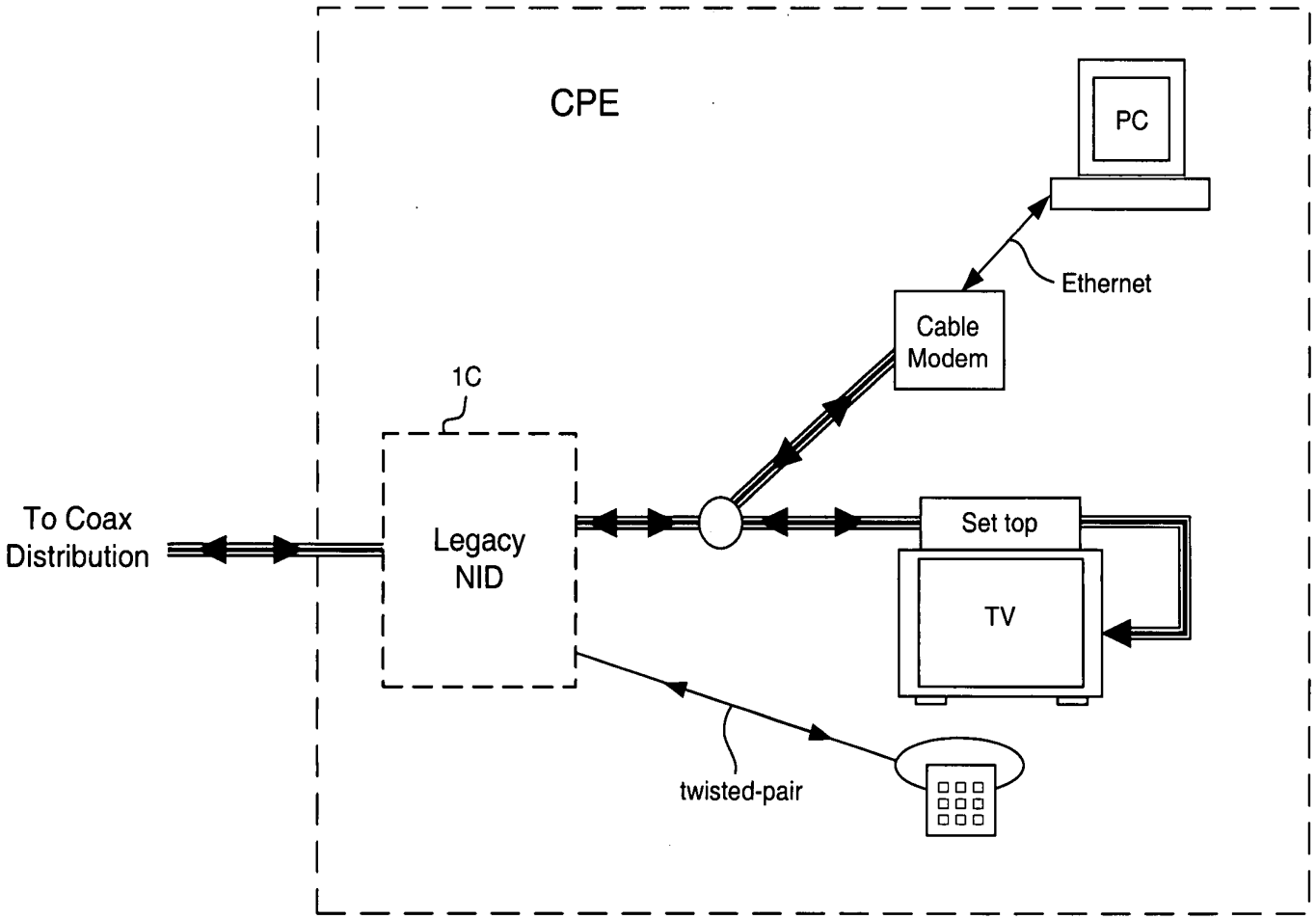
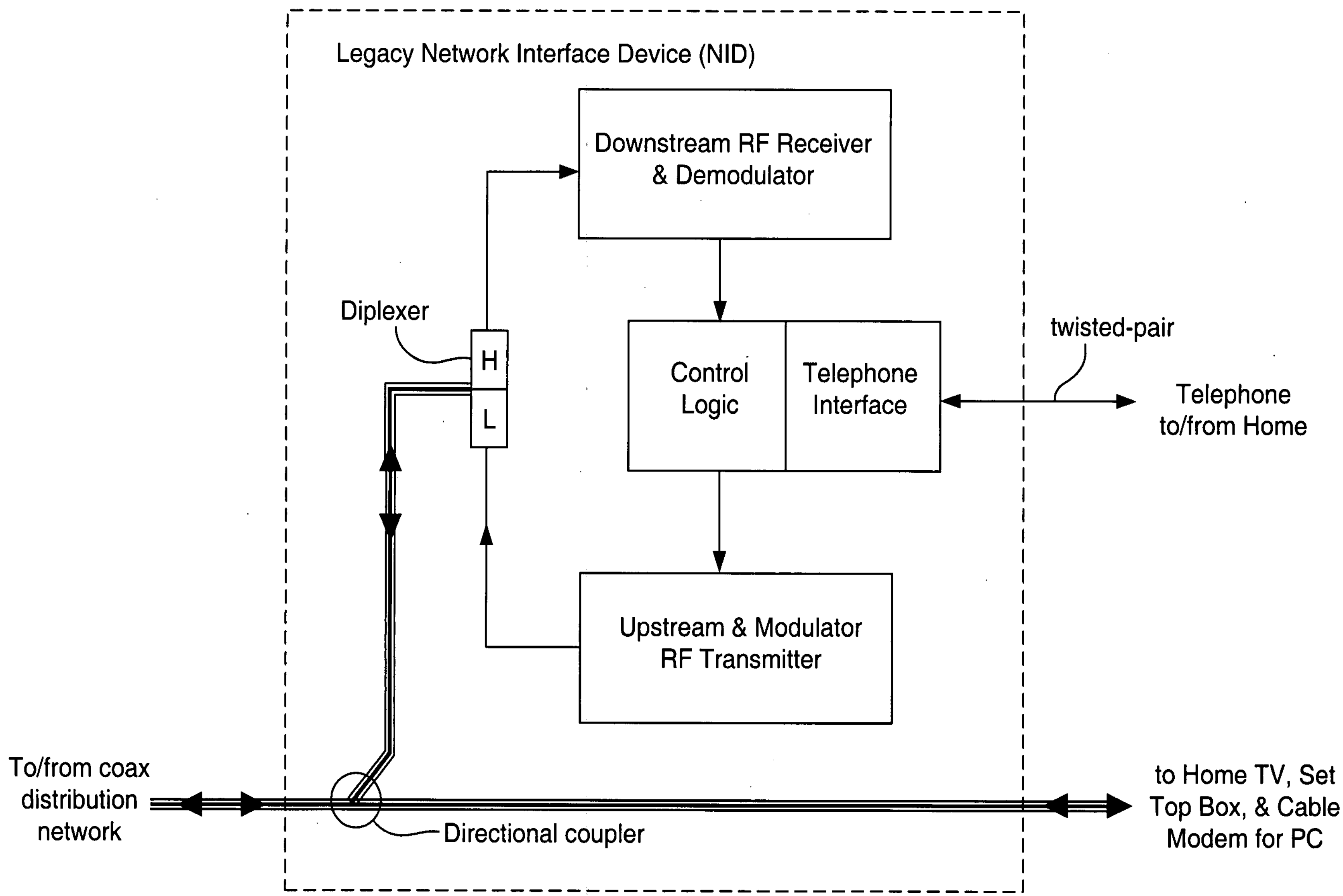


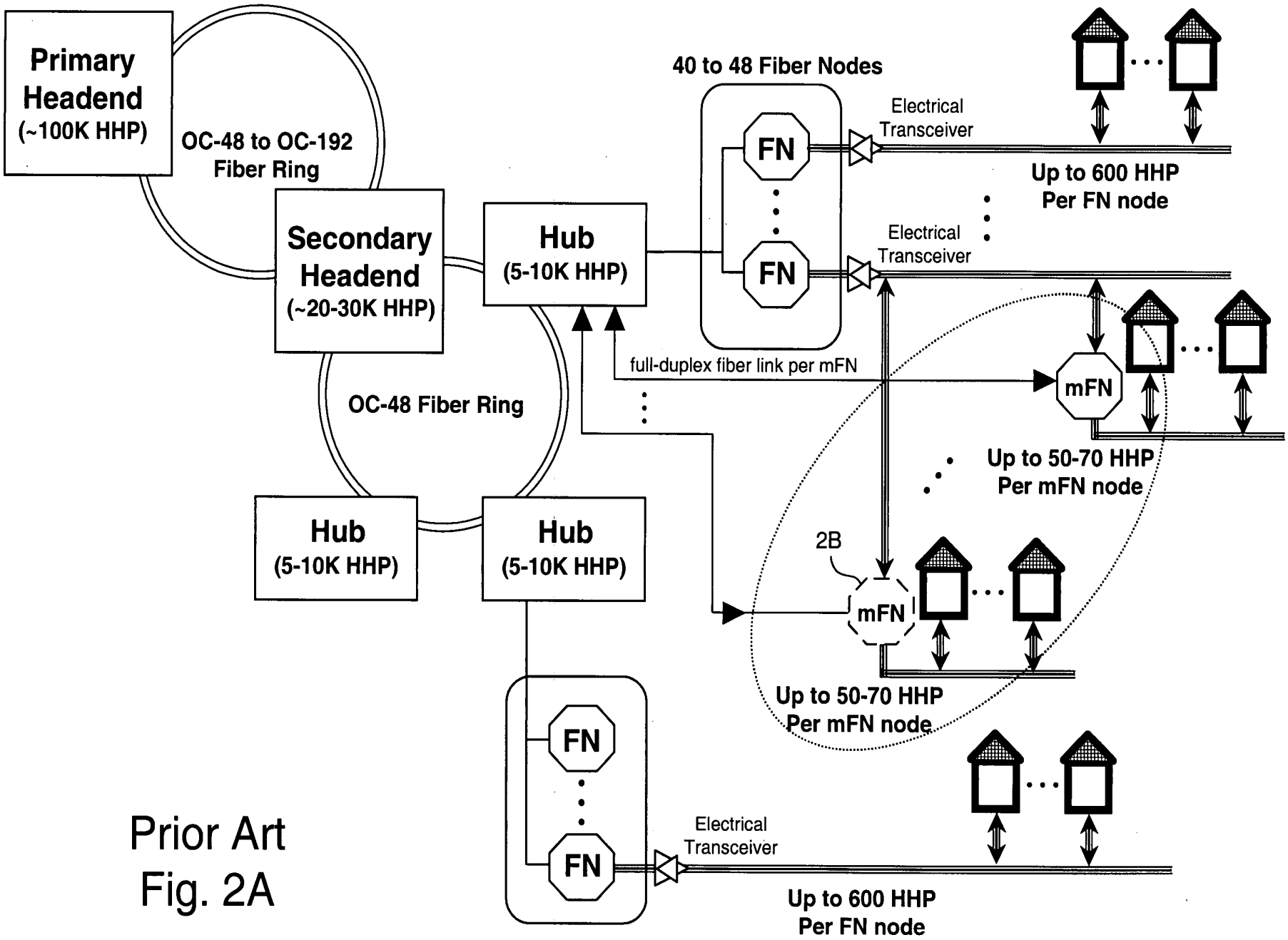
Prior Art
Fig. 1A



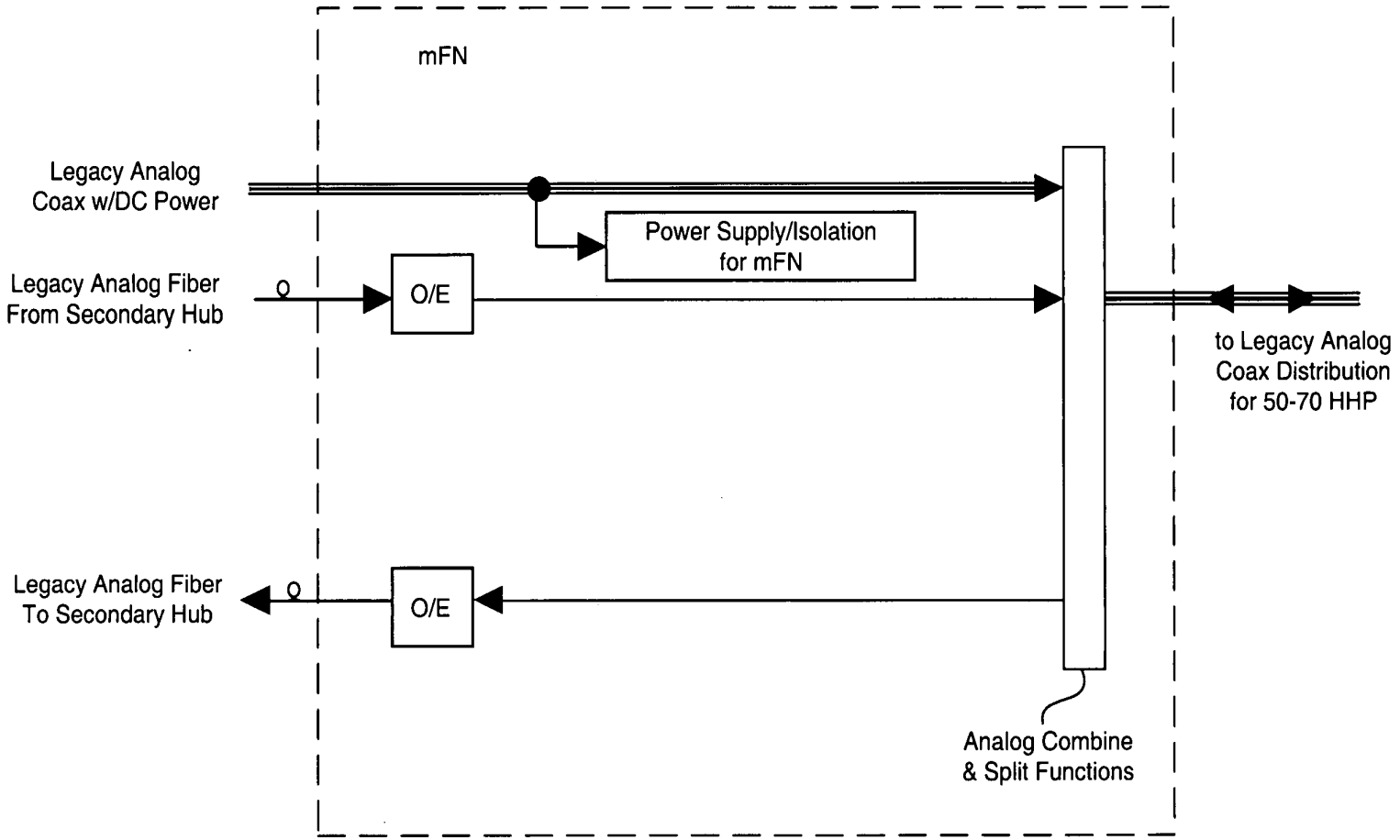
Prior Art
Fig. 1B



Prior Art
Fig. 1C



Prior Art
Fig. 2A



Prior Art
Fig. 2B

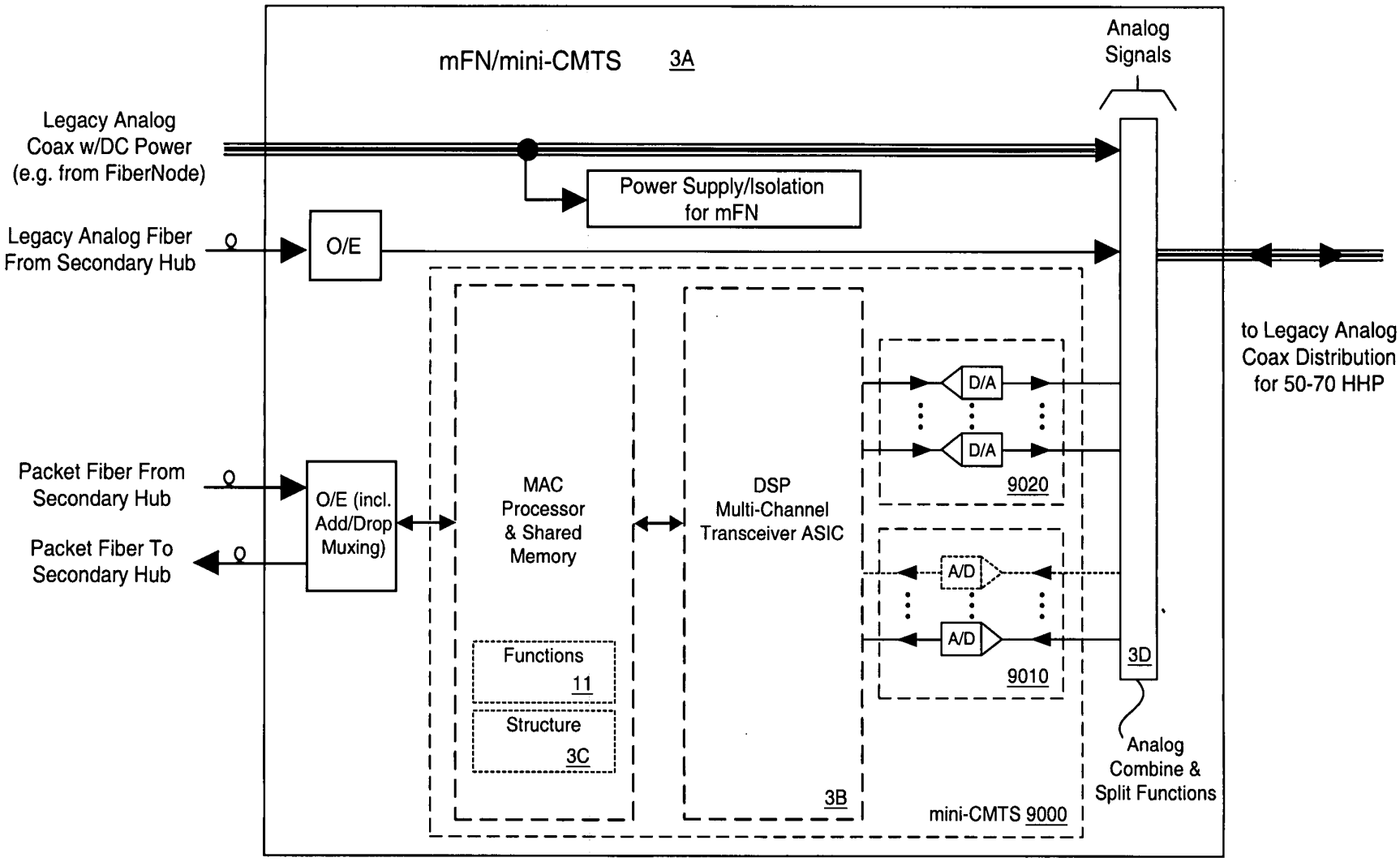

mFN/mini-CMTS 3A
Analog Signals
Legacy Analog Coax w/DC Power (e.g. from FiberNode)
Power Supply/Isolation for mFN
Legacy Analog Fiber From Secondary Hub
O/E
to Legacy Analog Coax Distribution for 50-70 HHP
Packet Fiber From Secondary Hub
Packet Fiber To Secondary Hub
O/E (incl. Add/Drop Muxing)
MAC Processor & Shared Memory
DSP Multi-Channel Transceiver ASIC
D/A
D/A
9020
A/D
A/D
9010
3D
Functions 11
Structure 3C
3B
mini-CMTS 9000
Analog Combine & Split Functions

Fig. 3A

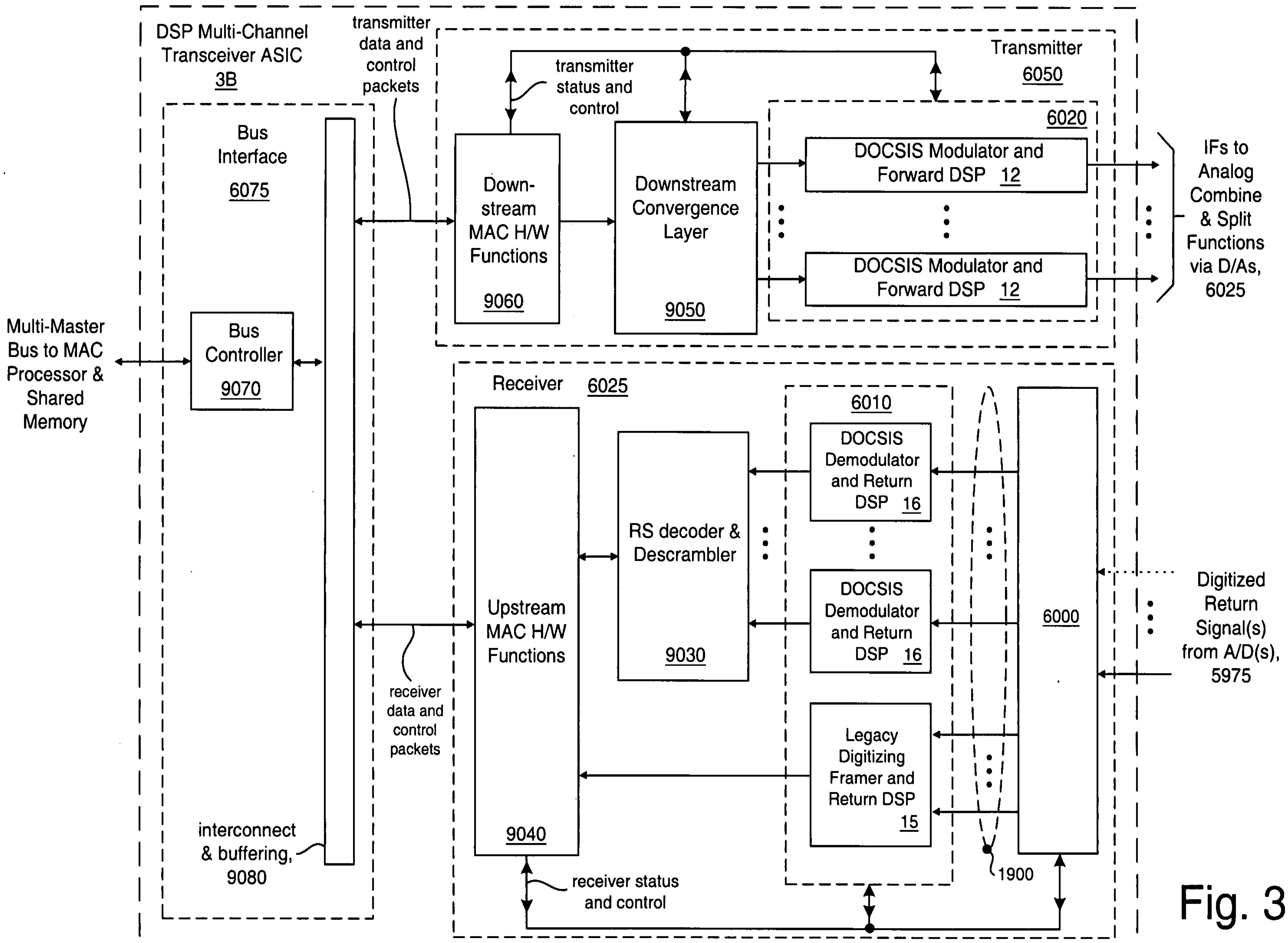

DSP Multi-Channel Transceiver ASIC 3B
Bus Interface 6075
Bus Controller 9070
Multi-Master Bus to MAC Processor & Shared Memory
interconnect & buffering, 9080
transmitter data and control packets
transmitter status and control
Transmitter 6050
Down-stream MAC H/W Functions 9060
Downstream Convergence Layer 9050
6020
DOCSIS Modulator and Forward DSP 12
DOCSIS Modulator and Forward DSP 12
IFs to Analog Combine & Split Functions via D/As, 6025
Receiver 6025
receiver data and control packets
Upstream MAC H/W Functions 9040
RS decoder & Descrambler 9030
6010
DOCSIS Demodulator and Return DSP 16
DOCSIS Demodulator and Return DSP 16
Legacy Digitizing Framer and Return DSP 15
6000
1900
Digitized Return Signal(s) from A/D(s), 5975
receiver status and control

Fig. 3B

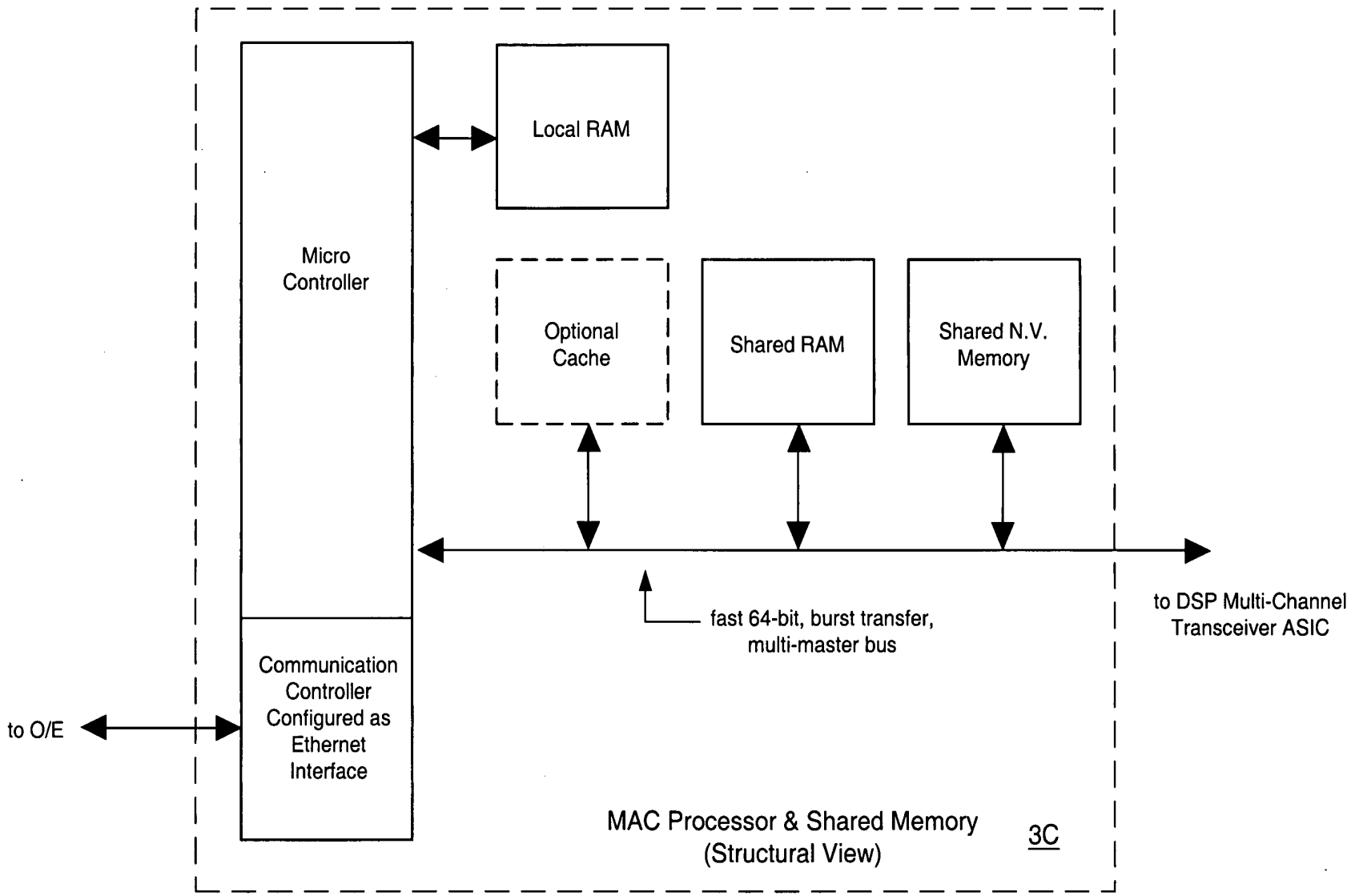


Fig. 3C

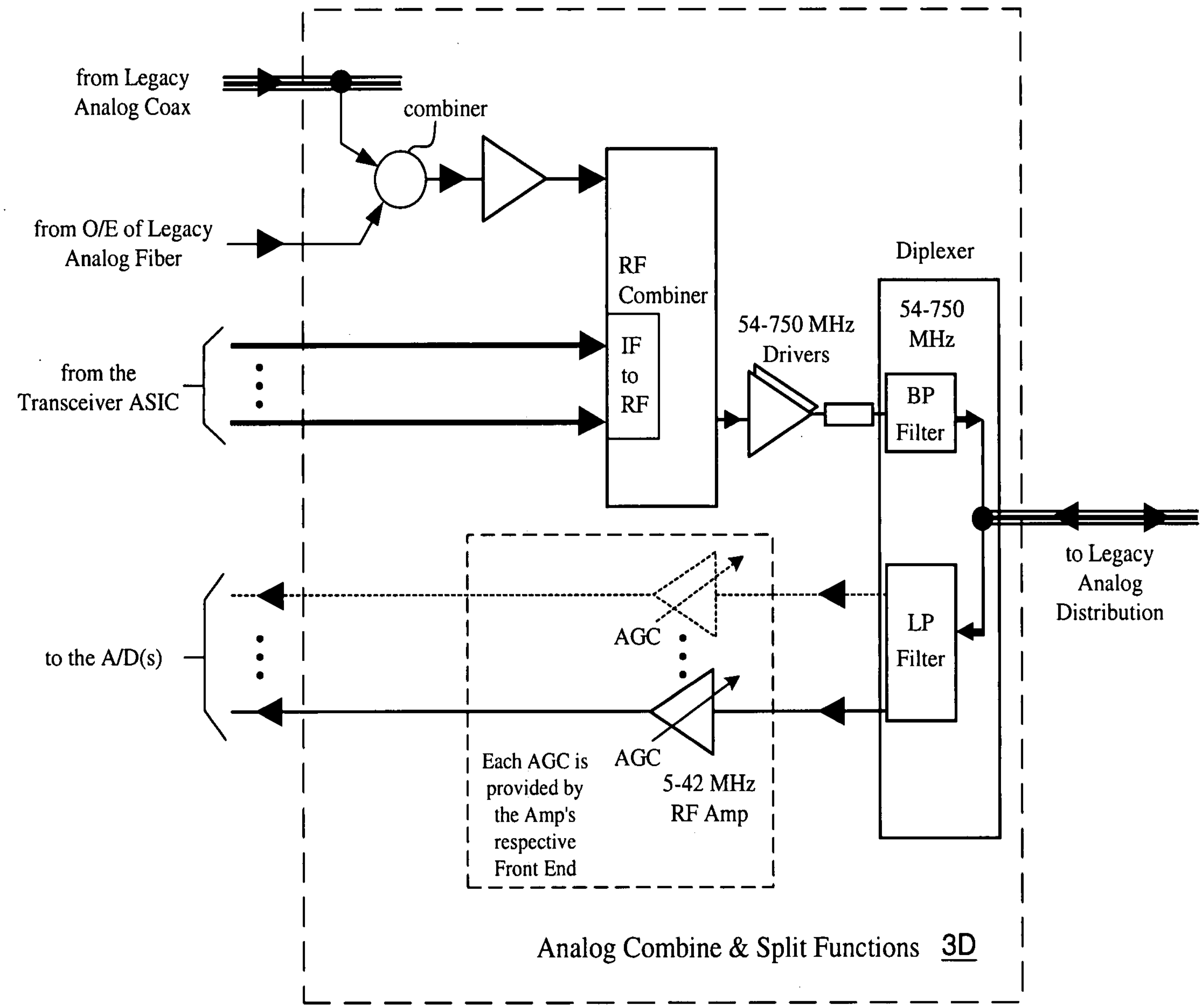

from Legacy Analog Coax
combiner
from O/E of Legacy Analog Fiber
RF Combiner
IF to RF
from the Transceiver ASIC
54-750 MHz Drivers
Diplexer
54-750 MHz
BP Filter
LP Filter
to Legacy Analog Distribution
to the A/D(s)
AGC
AGC
Each AGC is provided by the Amp's respective Front End
5-42 MHz RF Amp
Analog Combine & Split Functions 3D

Fig. 3D

Fig. 4A

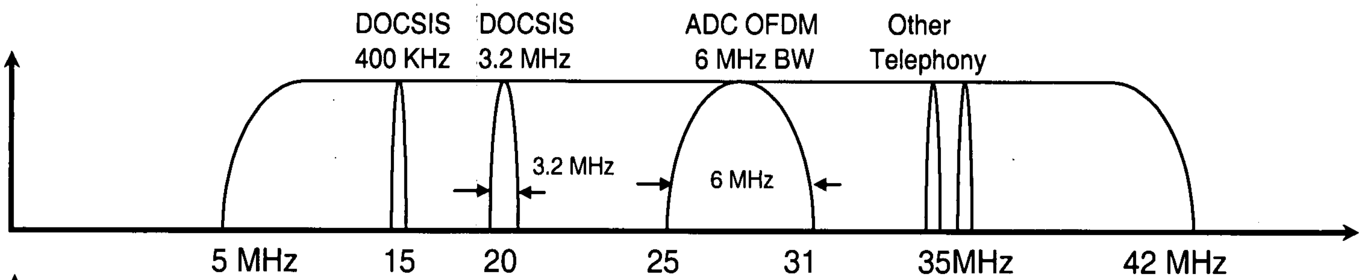


Fig. 4B

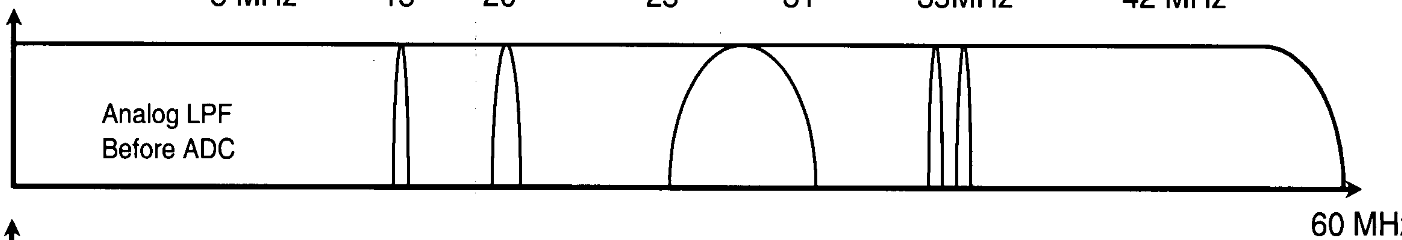


Fig. 4C

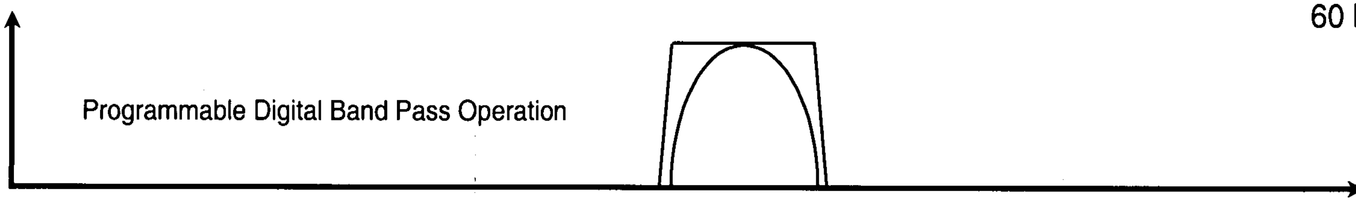


Fig. 4D

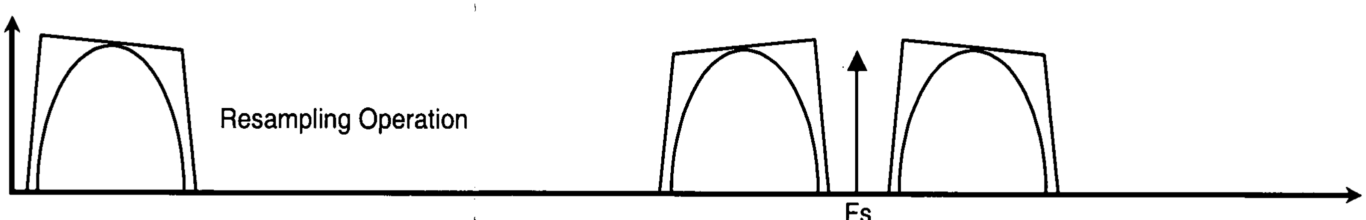
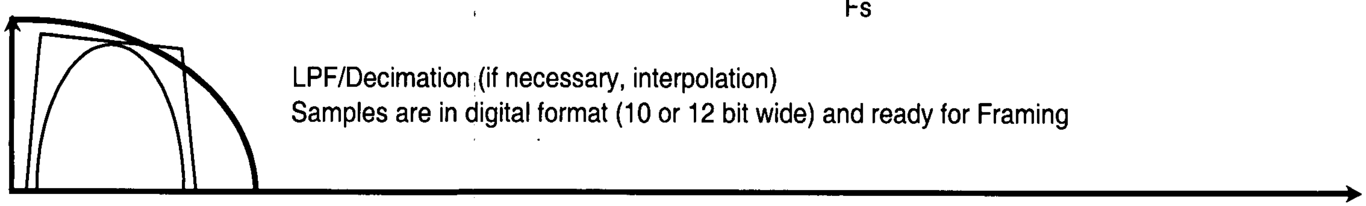


Fig. 4E



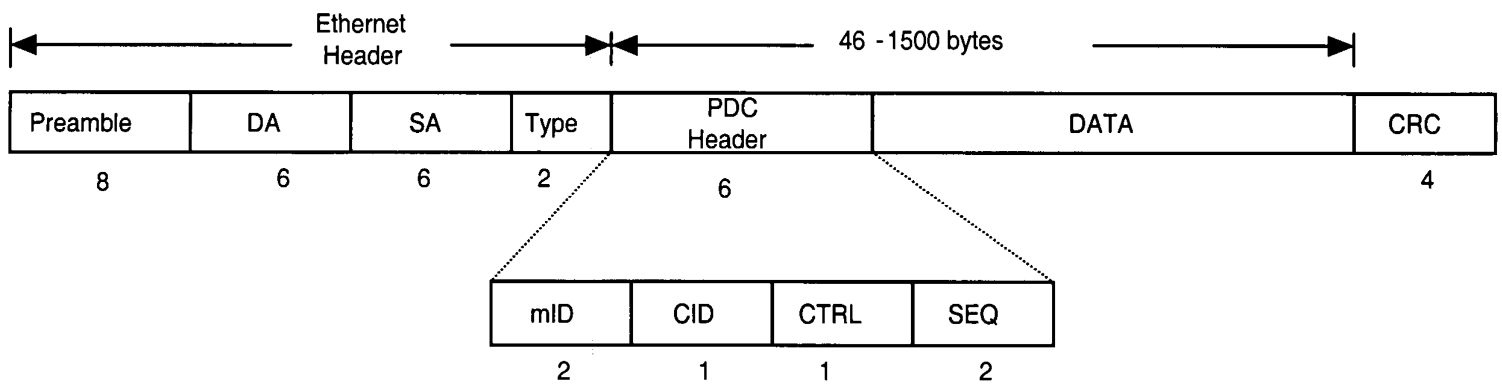

Ethernet
Header
46 -1500 bytes
Preamble
DA
SA
Type
PDC
Header
DATA
CRC
8
6
6
2
6
4
mID
CID
CTRL
SEQ
2
1
1
2

Fig. 5

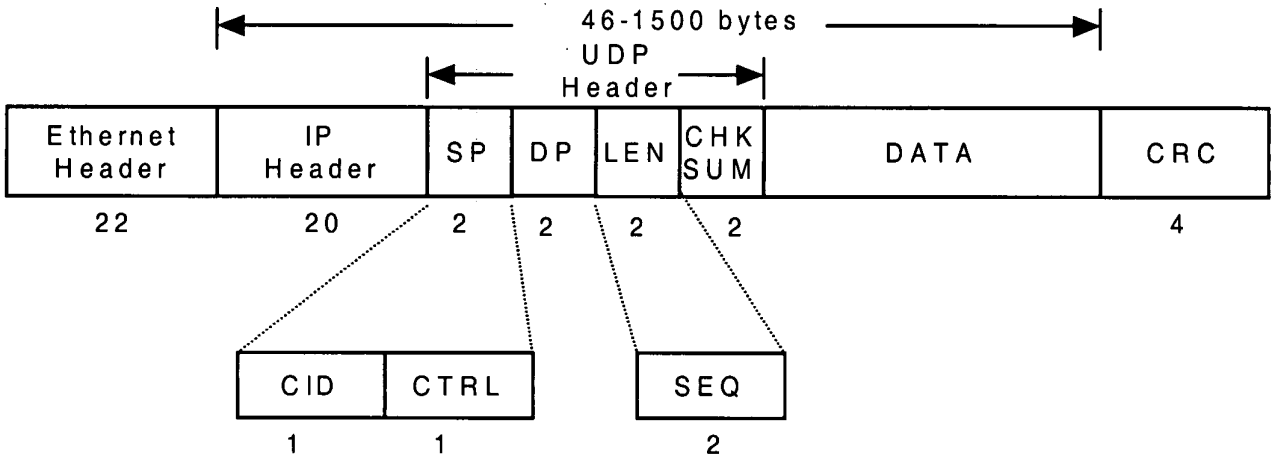


Fig. 6

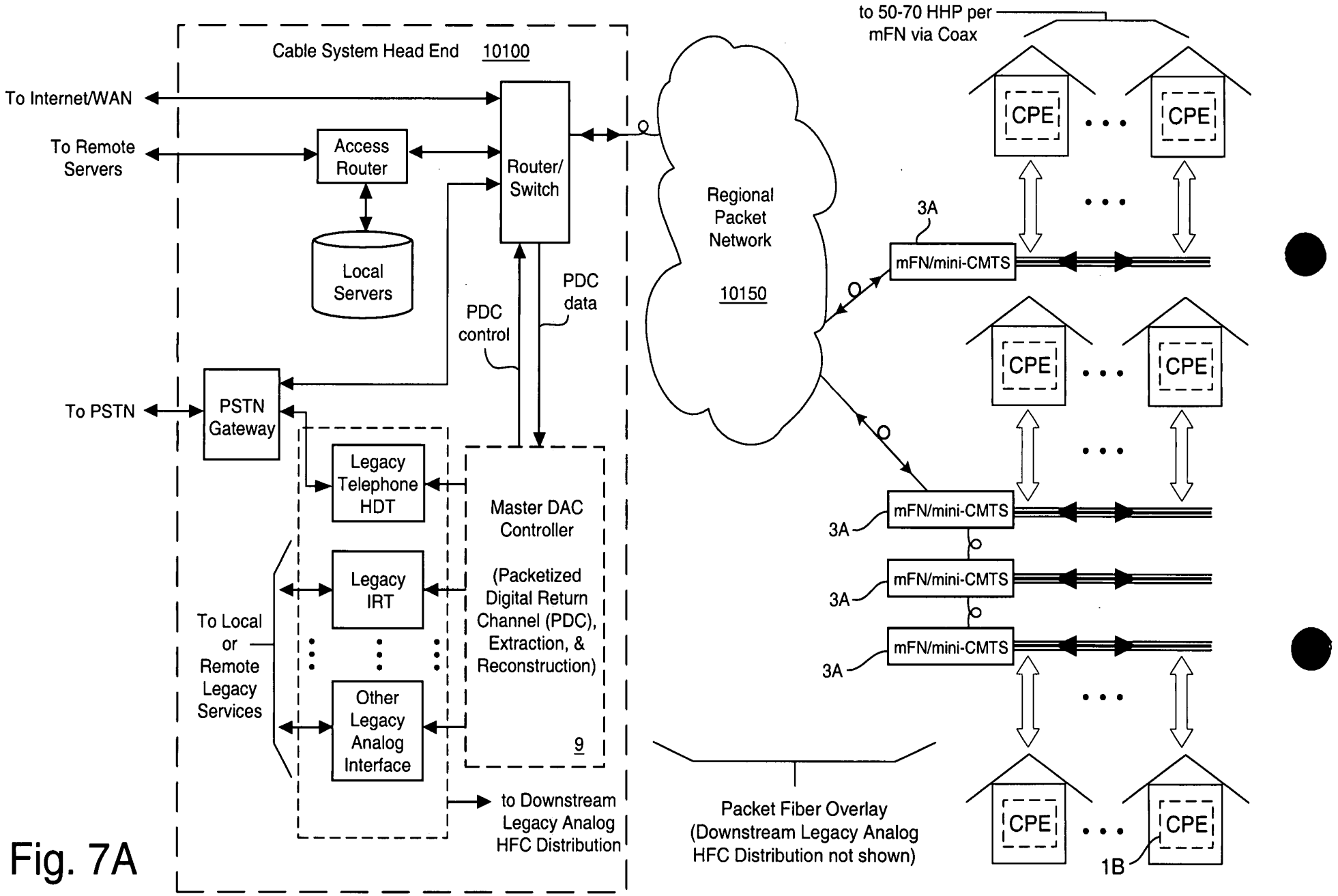

Cable System Head End 10100
To Internet/WAN
To Remote Servers
Access Router
Router/ Switch
Local Servers
PDC control
PDC data
To PSTN
PSTN Gateway
Legacy Telephone HDT
Legacy IRT
Other Legacy Analog Interface
Master DAC Controller
(Packetized Digital Return Channel (PDC), Extraction, & Reconstruction)
9
To Local or Remote Legacy Services
to Downstream Legacy Analog HFC Distribution
Regional Packet Network
10150
to 50-70 HHP per mFN via Coax
CPE
3A
mFN/mini-CMTS
Packet Fiber Overlay
(Downstream Legacy Analog HFC Distribution not shown)
1B

Fig. 7A

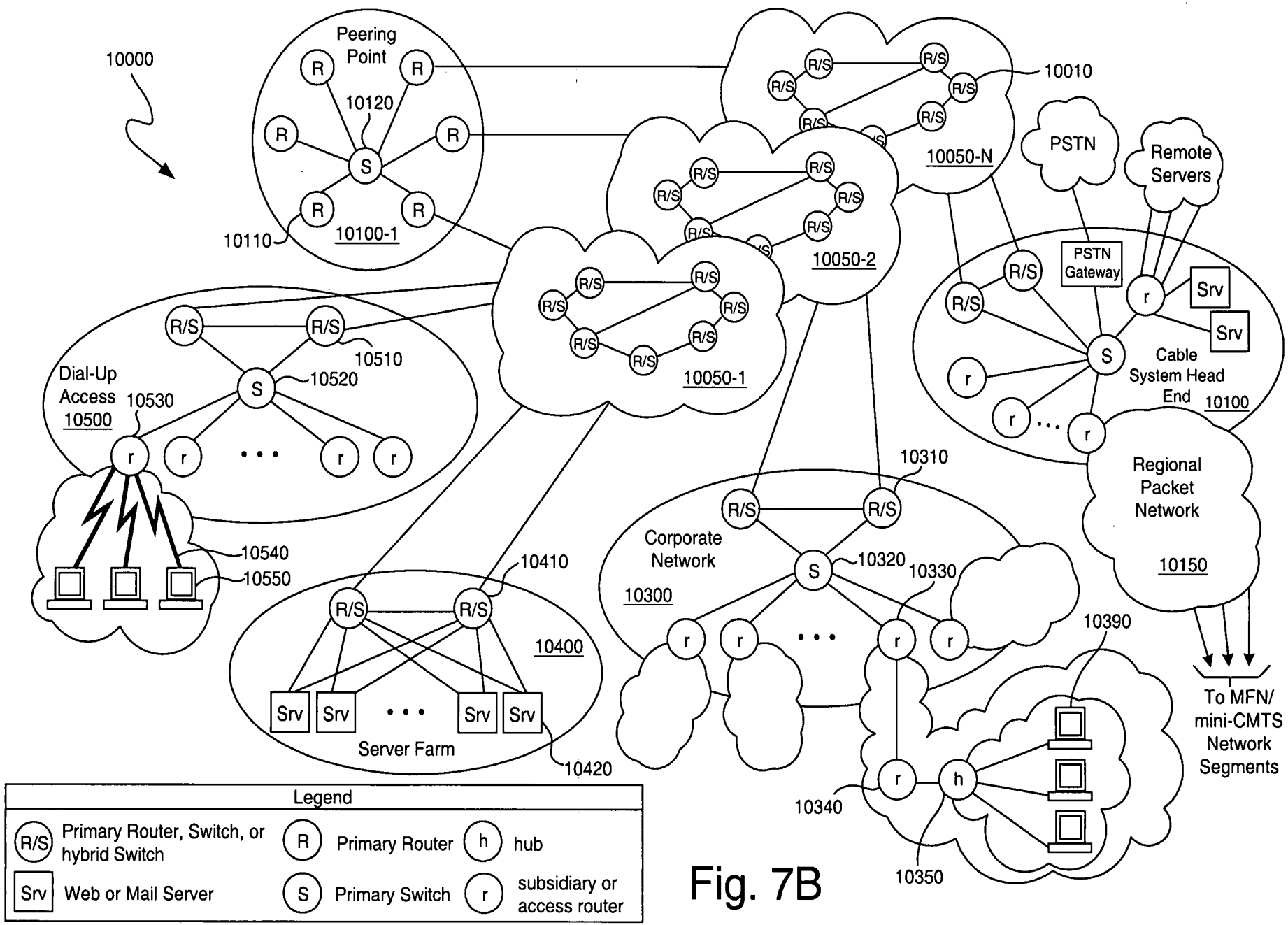

10000
Peering Point
10120
10100-1
10110
10010
10050-N
10050-2
10050-1
PSTN
Remote Servers
PSTN Gateway
Srv
Srv
Cable System Head End
10100
Regional Packet Network
10150
Dial-Up Access
10500
10530
10510
10520
10540
10550
10410
10400
Server Farm
10420
10310
Corporate Network
10300
10320
10330
10390
10340
10350
To MFN/ mini-CMTS Network Segments
Legend
Primary Router, Switch, or hybrid Switch
Primary Router
hub
Web or Mail Server
Primary Switch
subsidiary or access router

Fig. 7B

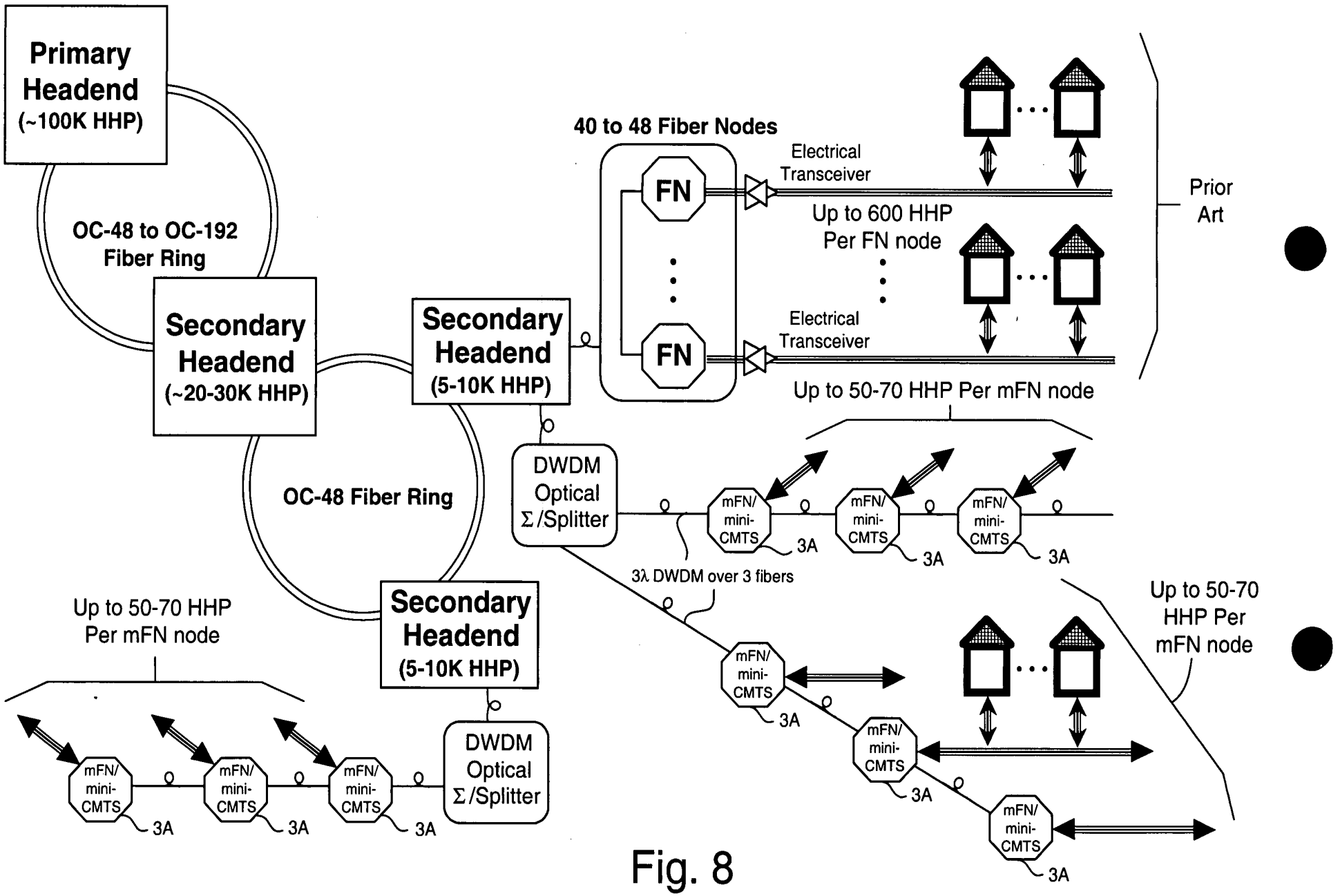

Primary Headend (~100K HHP)
OC-48 to OC-192 Fiber Ring
Secondary Headend (~20-30K HHP)
OC-48 Fiber Ring
Secondary Headend (5-10K HHP)
Secondary Headend (5-10K HHP)
40 to 48 Fiber Nodes
FN
FN
Electrical Transceiver
Electrical Transceiver
Up to 600 HHP Per FN node
Prior Art
Up to 50-70 HHP Per mFN node
DWDM Optical Σ/Splitter
DWDM Optical Σ/Splitter
3λ DWDM over 3 fibers
mFN/ mini-CMTS
3A
Up to 50-70 HHP Per mFN node
Up to 50-70 HHP Per mFN node

Fig. 8

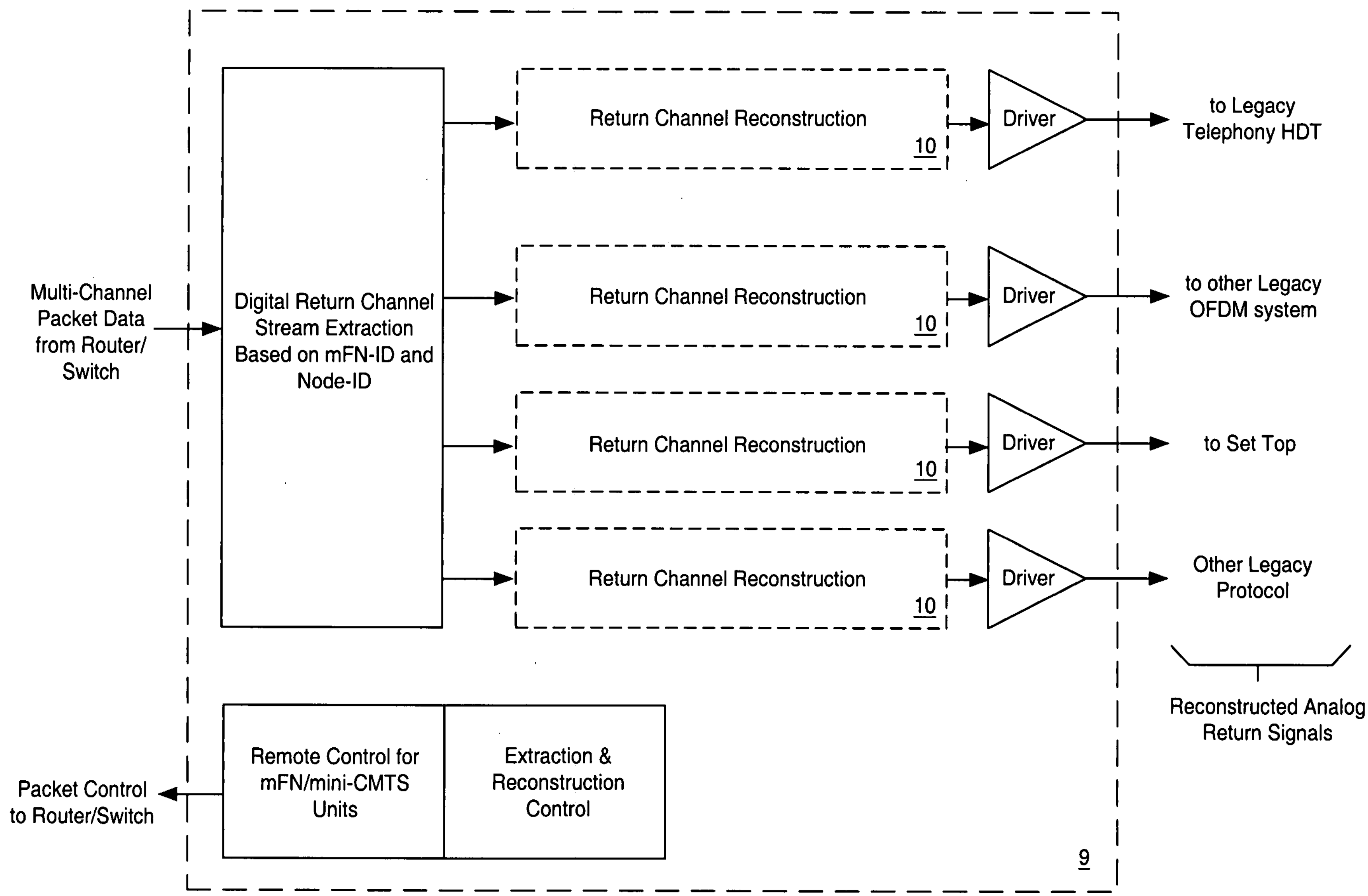

Multi-Channel Packet Data from Router/ Switch
Digital Return Channel Stream Extraction Based on mFN-ID and Node-ID
Return Channel Reconstruction
10
Driver
to Legacy Telephony HDT
to other Legacy OFDM system
to Set Top
Other Legacy Protocol
Reconstructed Analog Return Signals
Remote Control for mFN/mini-CMTS Units
Extraction & Reconstruction Control
Packet Control to Router/Switch
9

Fig. 9

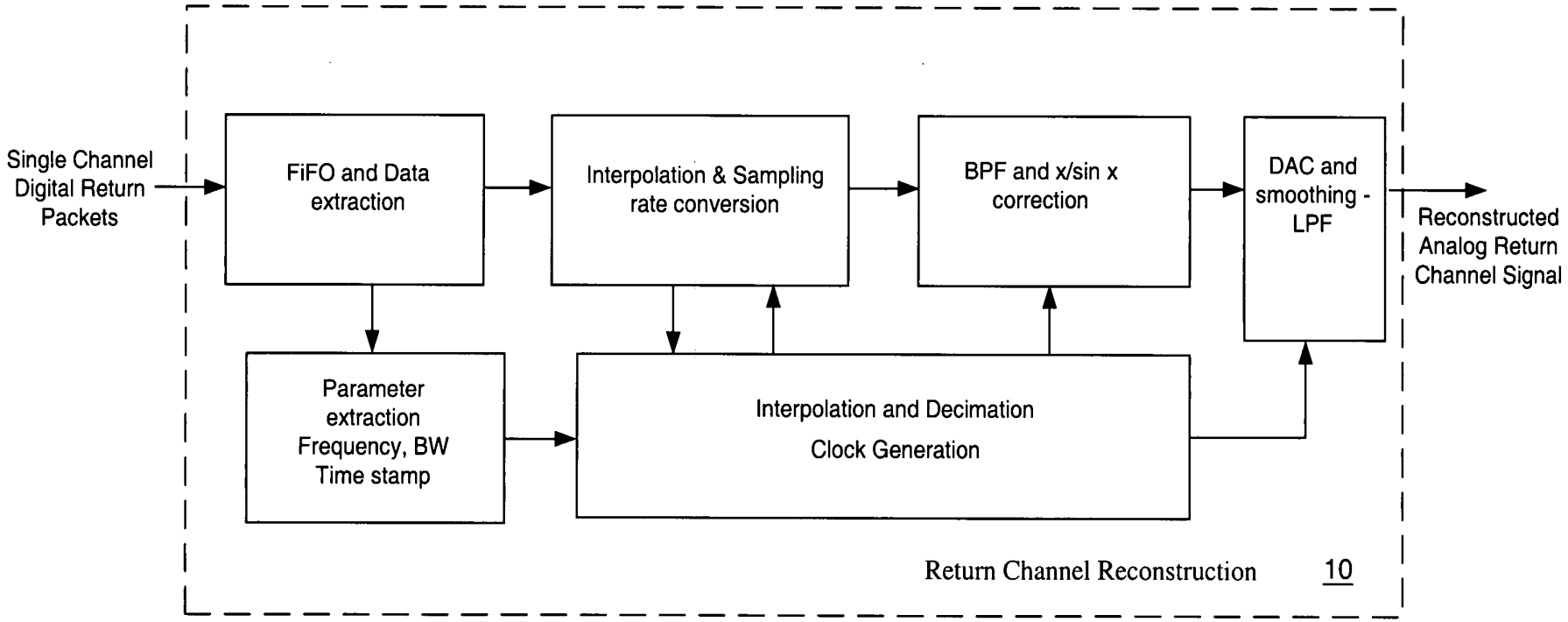

Single Channel Digital Return Packets
FiFO and Data extraction
Interpolation & Sampling rate conversion
BPF and x/sin x correction
DAC and smoothing - LPF
Reconstructed Analog Return Channel Signal
Parameter extraction Frequency, BW Time stamp
Interpolation and Decimation Clock Generation
Return Channel Reconstruction 10

Fig. 10

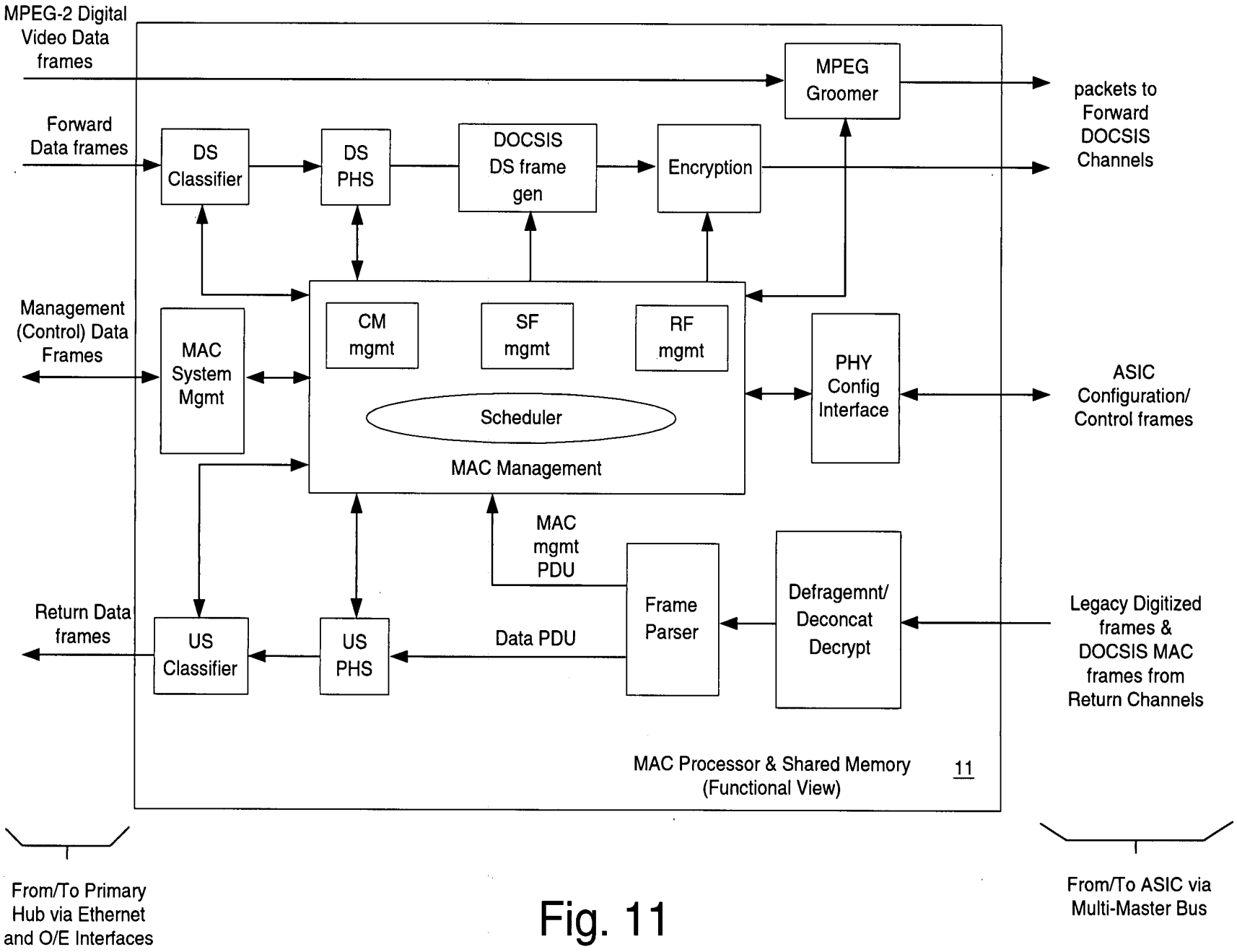

MPEG-2 Digital Video Data frames
MPEG Groomer
packets to Forward DOCSIS Channels
Forward Data frames
DS Classifier
DS PHS
DOCSIS DS frame gen
Encryption
Management (Control) Data Frames
MAC System Mgmt
CM mgmt
SF mgmt
RF mgmt
PHY Config Interface
ASIC Configuration/ Control frames
Scheduler
MAC Management
MAC mgmt PDU
Return Data frames
US Classifier
US PHS
Data PDU
Frame Parser
Defragemnt/ Deconcat Decrypt
Legacy Digitized frames & DOCSIS MAC frames from Return Channels
MAC Processor & Shared Memory (Functional View)
11
From/To Primary Hub via Ethernet and O/E Interfaces
From/To ASIC via Multi-Master Bus

Fig. 11

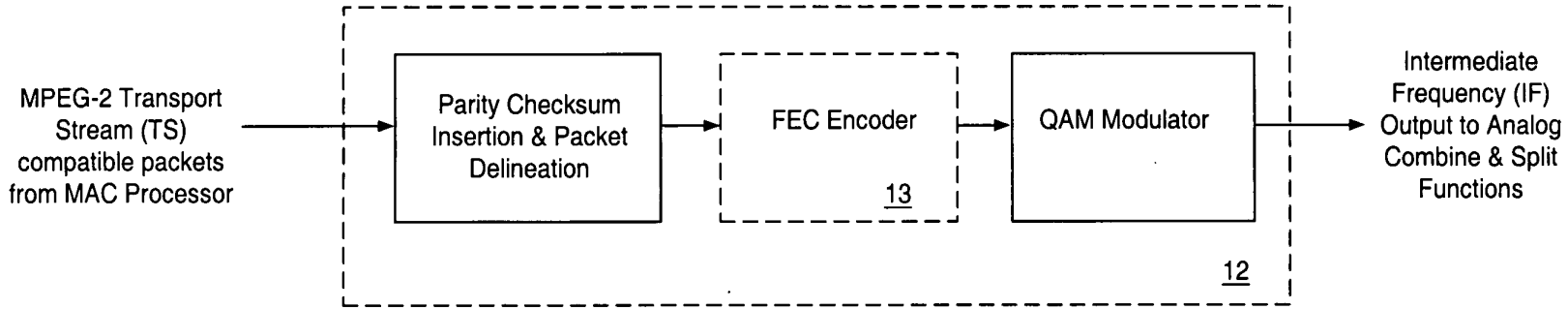

MPEG-2 Transport Stream (TS) compatible packets from MAC Processor
Parity Checksum Insertion & Packet Delineation
FEC Encoder
13
QAM Modulator
Intermediate Frequency (IF) Output to Analog Combine & Split Functions
12

Fig. 12

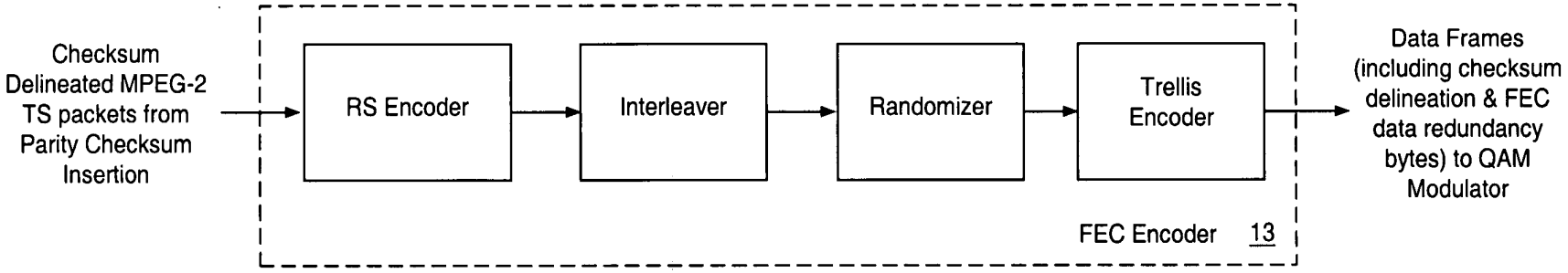

Checksum Delineated MPEG-2 TS packets from Parity Checksum Insertion
RS Encoder
Interleaver
Randomizer
Trellis Encoder
Data Frames (including checksum delineation & FEC data redundancy bytes) to QAM Modulator
FEC Encoder 13

Fig. 13

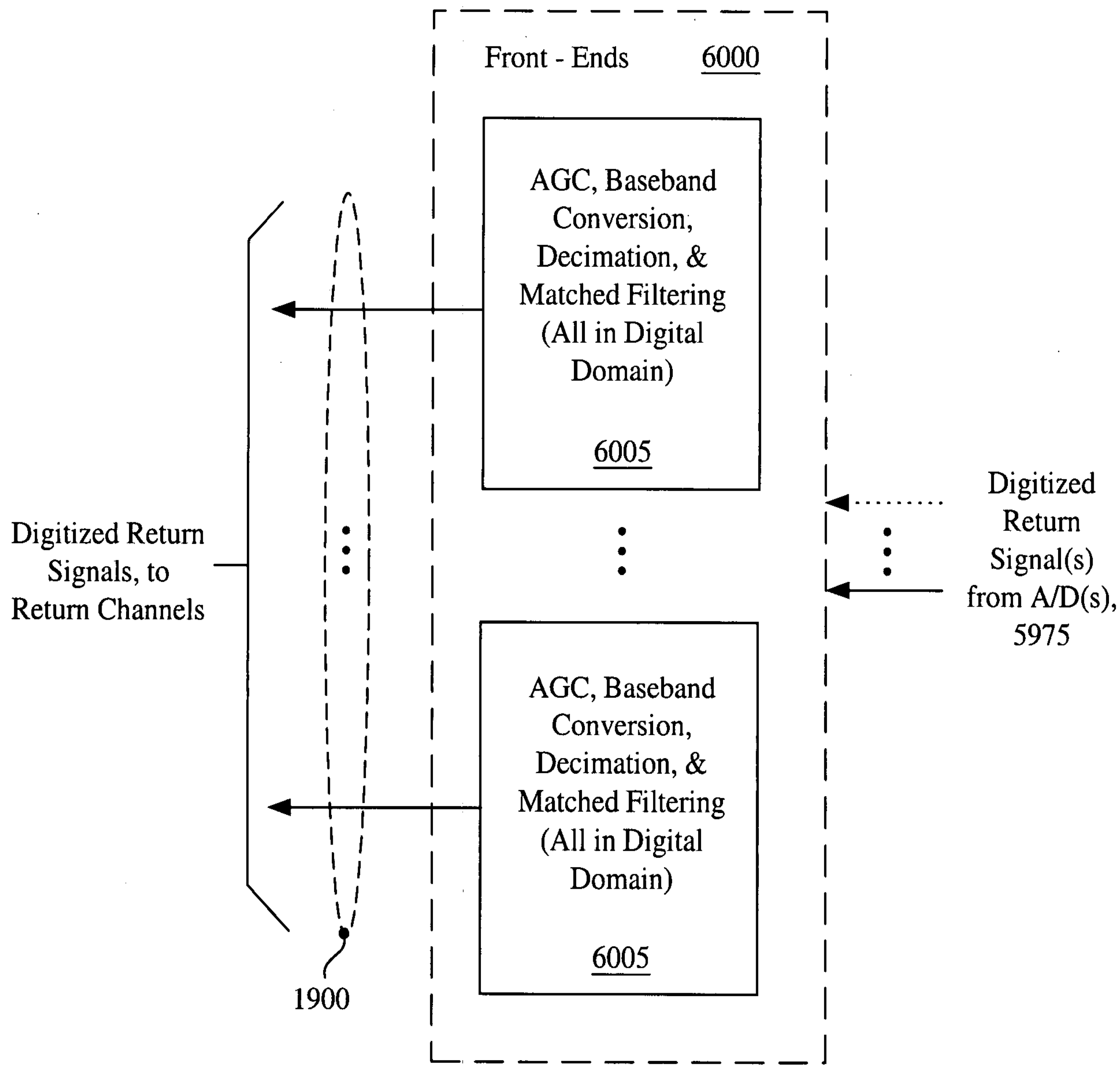

Front - Ends 6000
AGC, Baseband Conversion, Decimation, & Matched Filtering (All in Digital Domain)
6005
AGC, Baseband Conversion, Decimation, & Matched Filtering (All in Digital Domain)
6005
Digitized Return Signal(s) from A/D(s), 5975
Digitized Return Signals, to Return Channels
1900

Fig. 14

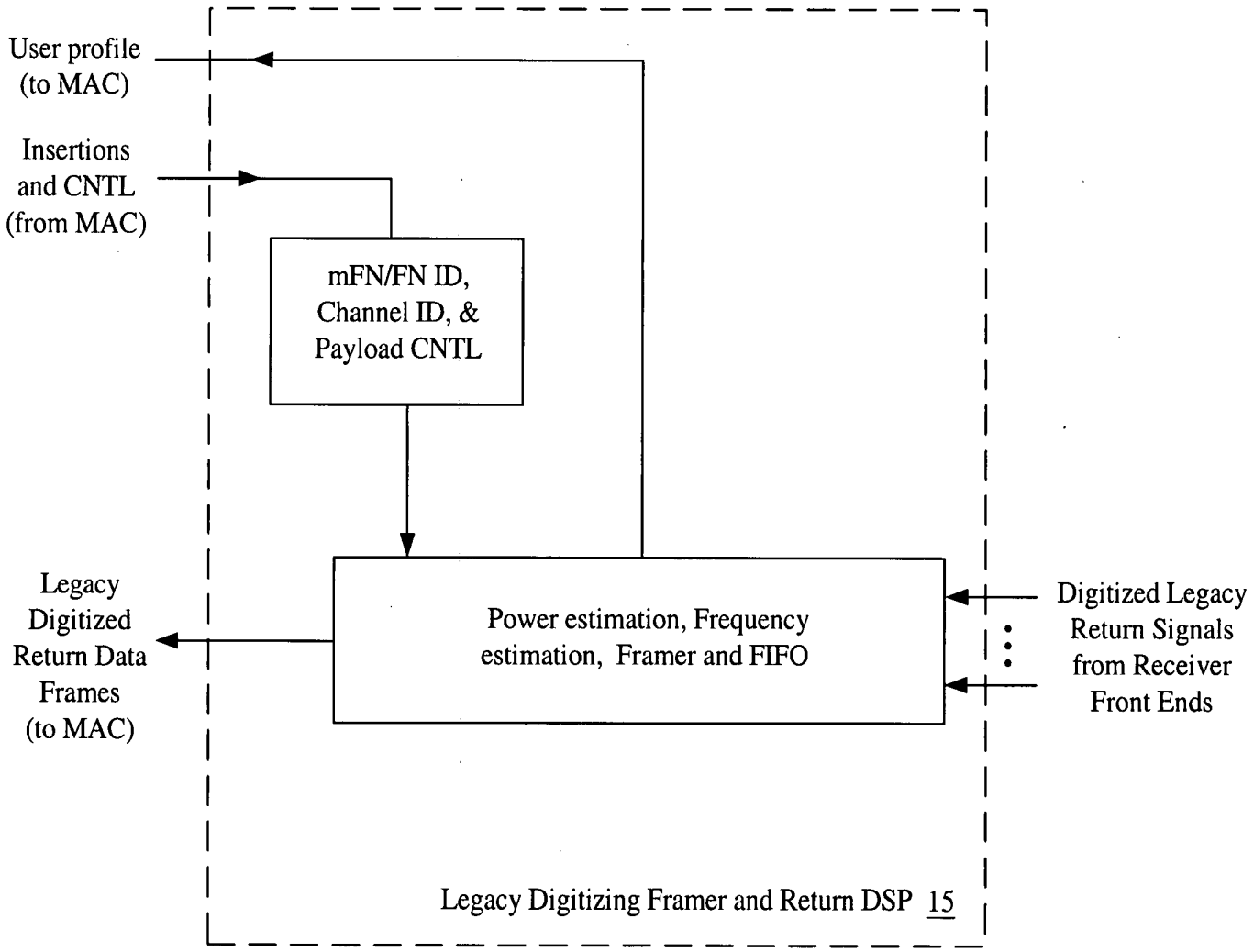

User profile
(to MAC)
Insertions
and CNTL
(from MAC)
mFN/FN ID,
Channel ID, &
Payload CNTL
Legacy
Digitized
Return Data
Frames
(to MAC)
Power estimation, Frequency
estimation, Framer and FIFO
Digitized Legacy
Return Signals
from Receiver
Front Ends
Legacy Digitizing Framer and Return DSP 15

Fig. 15

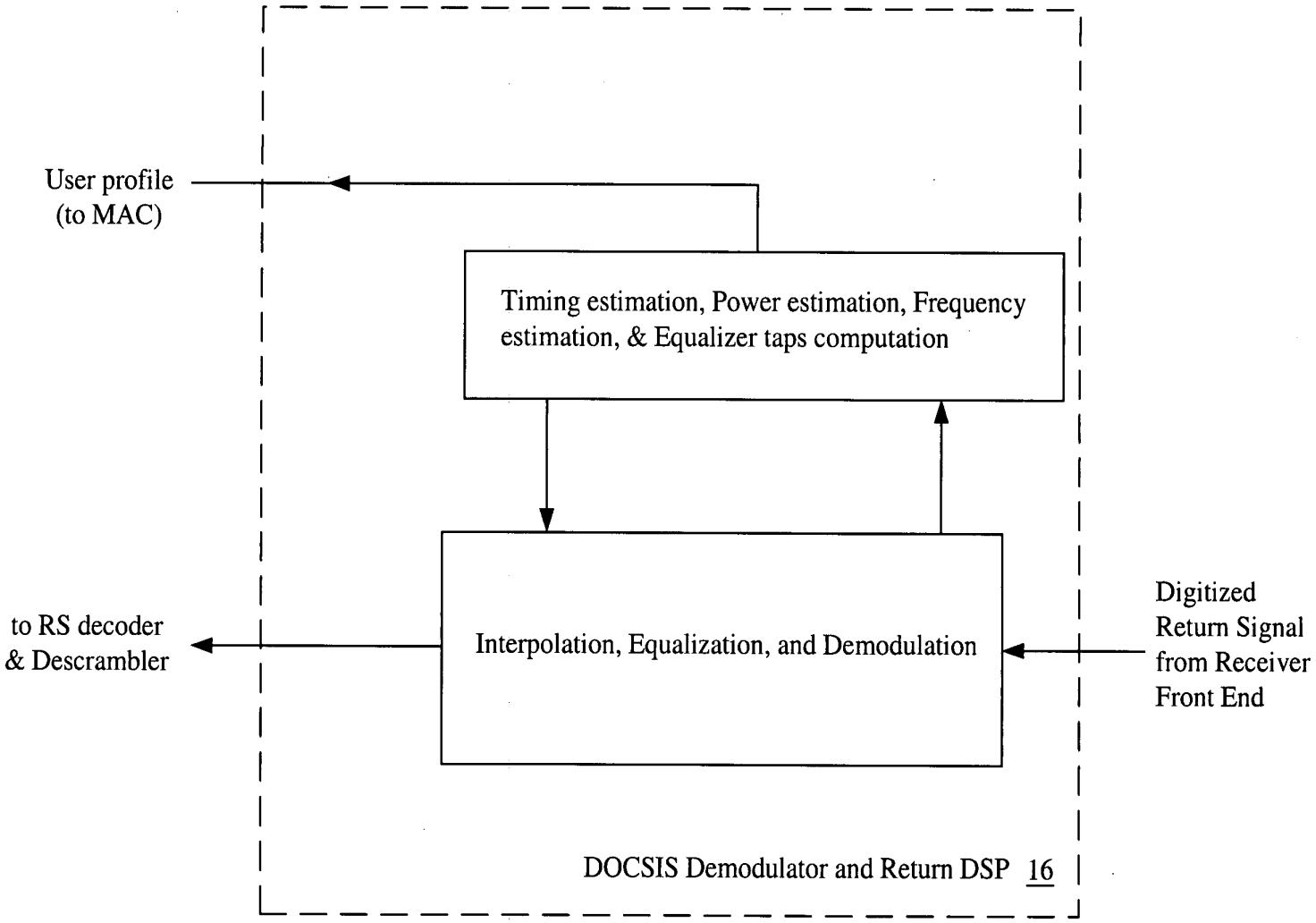

User profile
(to MAC)
Timing estimation, Power estimation, Frequency estimation, & Equalizer taps computation
to RS decoder
& Descrambler
Interpolation, Equalization, and Demodulation
Digitized
Return Signal
from Receiver
Front End
DOCSIS Demodulator and Return DSP 16

Fig. 16